Q1 Ans

Sol $R = 300m \qquad \Delta = 60^\circ$

(a) Arc definition :- $S = 30m$,

$$R = \frac{S}{D_a} \times \frac{180}{\pi}$$

$$300 = \frac{30 \times 180}{D_a \pi} \quad \text{or } D_a = 5.73$$

(b) chord definition

$$R = \sin \frac{D_c}{2} = \frac{S}{2}$$

$$300 \sin \frac{D_c}{2} = \frac{30}{2}$$

$$DC = 5.732$$

(i) length of curve :

$$l = R\Delta \frac{\pi}{180} = 300 \times 60 \times \frac{\pi}{180} = 314.16m$$

(ii) Tangent length :-

$$T = R\tan \frac{\Delta}{2} = 300 \tan \frac{60}{2} = 173.21$$

(3) Length of long chord -

$L = 2R \sin\frac{\Delta}{2} = 2 \times 300 \times \sin\frac{60}{2} = 300m$

(4) Mid ordinate

$M = R\left(1-\cos\frac{\Delta}{2}\right)$

$= 300\left(1-\cos\frac{60}{2}\right) = 40.19$

(5) Apex distance.

$E = R\left[\sec\frac{\Delta}{2} - 1\right]$

$= 300\left[\sec\frac{60}{2} - 1\right]$

$= 46.41m$

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Question 2

Two roads having a deviation angle of 45° at apex point V are to be joined by a 200m radius circular curve. If the chainage of apex point is 1839.2m and peg interval being 10m, calculate necessary data to set the curve by:-

- Offset from chords (use peg interval 20 if needed)

Sol:-

$R = 200m \quad \Delta = 45°$

$\therefore$ length of tangent $= 200 \tan 45/2$
$= \boxed{82.84m}$

$\therefore$ chainage of $T_1 = 1839.2 - 82.84$
$= \boxed{1756.36m}$

length of curve $= R \times 45 \times \pi/180$
$= \boxed{157.08m}$

chainage of forward tangent T_2
$= 1756.36 + 157.08 = 1913.44m$

(a) By offsets from long chord:-

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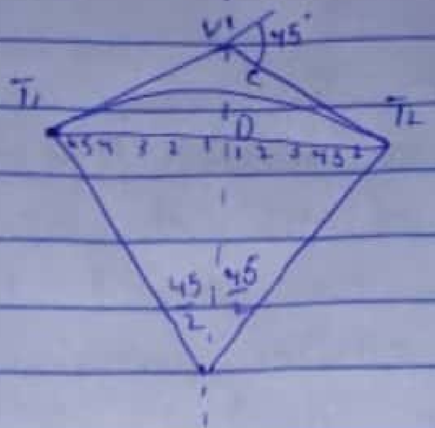

Distance of DT = L/2 = $R \sin\frac{\Delta}{2} = 200 \sin 45/2$
$= \boxed{76.54}$

Measuring 'x' from D

$y = \sqrt{R^2 - x^2} - \sqrt{R^2 - (L/2)^2}$

At $x = 0$

$O_0 = 200 - \sqrt{200^2 - 76.54^2} = 200 - 184.78$
$= \boxed{15.22m}$

$O_1 = \sqrt{(200)^2 - (10)^2} - 184.78 = 14.97m$

$O_2 = \sqrt{(200)^2 - (20)^2} - 184.78 = 14.22m$

$O_3 = \sqrt{(200)^2 - (30)^2} - 184.78 = 12.96m$

$O_4 = \sqrt{(200)^2 - (40)^2} - 184.78 = 11.18m$

$O_5 = \sqrt{(200)^2 - (50)^2} - 184.78 = 8.87m$

$O_6 = \sqrt{(200)^2 - (60)^2} - 184.78 = 6.01m$

$O_7 = \sqrt{(200)^2 - (70)^2} - 184.78 = 2.57m$

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T_1, 0 - 0.00

b) Method of bisection:-

central ordinate at $= D = R(1-\cos\frac{\Delta}{2})$

$= 200(1-\cos\frac{45}{2})$

$= 15.22$

ordinate at

$D_1 = R(1-\cos\frac{\Delta}{4}) = 200(1-\cos 45/4)$

$= 3.84m$

ordinate at

$D_2 = R(1-\cos\Delta/8) = 200(1-\cos 45/8)$

$= 0.96m$

c) offsets from chord produced:-

length of first sub-chord

c) offsets from tangents:

$O_x = \sqrt{R^2 + x^2} - R$

chainage of $T_1 =$ ~~17~~56.36m

for 30m chain it is at

$= 55$ chains $+ 16.36m$

$x_1 = 30 - 16.36 = 13.64$

$x_2 = 43.64$

$x_3 = 73.64m$

and last is at $x_4 =$ tangent length $= 82.84$

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$O_1 = \sqrt{(200)^2 + (13.64)^2} - 200 = 0.46m$

$O_2 = \sqrt{(200)^2 + (43.64)^2} - 200 = 4.71m$

$O_3 = \sqrt{(200)^2 + (73.64)^2} - 200 = 13.13m$

$O_4 = \sqrt{(200)^2 + (82.84)^2} - 200 = 16.48m$

d) offsets from chord produced
length of first sub-chord = 13.64 = c_1
length of normal chord = 30 = c_2

since length chain is 157.08m $c_3 = c_4 = c_5 = 30$

chainge of forward tangent = 1913.44m
= 63 chains + 23.44m

$$O_1 = \frac{c_1^2}{2R} = \frac{13.64^2}{2 \times 200} = 0.47$$

$$O_2 = \frac{c_2(c_1 + c_2)}{2R} = \frac{30(30 + 13.64)}{2 \times 200} = 3.27$$

$$O_4 = \frac{c_n(c_{n-1} + c_n)}{2R} = \frac{23.44(23.44 + 30)}{2 \times 200}$$

$= 3.13m$

③

Q3 Ans Sol

$R = 17.5 \times 20 = 350m$

$\Delta = 32^\circ 40'$

$\frac{\Delta}{2} = 16^\circ 20'$

Tangent length $T = R\tan\frac{\Delta}{2}$

$= 350 \times \tan 16^\circ 20' = 102.57m$

Length of curve $l = \frac{\pi R \Delta}{180}$

$= \frac{\pi \times 250 \times 32.667}{180} = 199.55m$

Charage of T_1 = chaing of P.I − T

$= (51 + 9.35) - 102.57$

$= (51 \times 20 + 9.35) - 102.57$

$= 926.78\ m$

$= 46 + 6.78$

Chainge of T_2 = chainge of $T_1 + l$

$= 926.78 + 199.55 = 1226.33m$

$= 56 + 6.33$

length of first sub-chord

$C_f = (46+20) - (46 + 6.78) = 15.22 m$

length of last subchord C_L

$C_L = (56 + 6.33) - (56+0) = 6.33m$

Number of normal chords

$N = 56 - 47 = 9$

Total number of chord

$n = 9+2 = 11$

Coordinate of T_1 and T_2

Bearing of $IT_1 = \alpha = 180^\circ +$ bearing of TI

$= 180 + 78^\circ 36' 30''$

$= 258^\circ 36' 30''$

Bearing of $IT_2 = \beta =$ Bearing of $IT - \phi$

$=$ Bearing of $IT_1 - (180^\circ - \Delta)$

$= 258^\circ 36' 30'' - (180 - 32^\circ 40')$

$= 111^\circ 16' 30''$

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Coordinate of T_1

Easting $= 958.00m$

Northing $N = 1024.78m$

coordinate of T_2

$E = 1154.13m$

$N = 1007.812m$

Tangent angle

$$\delta = 1718.9 \frac{C}{R} \text{ minutes}$$

$$\delta_1 = 1718.9 \frac{13.22}{350} = 64.925'$$

$$\delta_2 \text{ to } \delta_{10} = 1718.9 \frac{6.33}{350} = 98.223'$$

$$\delta_{11} = 1718.9 \frac{6.33}{350} = 31.088'$$

Deflection angle

$$\Delta_1 = \delta_1 = 64.925' = 1^\circ 04' 55''$$

$$\Delta_2 = \Delta_1 + \delta_2 = 64.925' + 98.223' = 163.148'$$

$$= 2^\circ 43' 09''$$

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$\Delta_3 = \Delta_2 + \delta_3 = 163.148' + 98.223' = 261.371'$

$= 4^\circ 21' 22''$

$\Delta_4 = \Delta_3 + \delta_4 = 261.371 + 98.223' = 359.594' = 5^\circ 59' 36''$

$\Delta_5 = \Delta_4 + \delta_5 = 359.594 + 98.223' = 457.817 = 7^\circ 37' 3$

$\Delta_6 = \Delta_5 + \delta_6 = 457.817 + ,, = 556.040' = 9^\circ 16' 02$

$\Delta_7 = \Delta_6 + \delta_7 = 556.040' + ,, = 654.263' = 10^\circ 54' 16''$

$\Delta_8 = \Delta_7 + \delta_8 = 654.263' + ,, = 752.486' = 12^\circ 32' 29$

$\Delta_9 = \Delta_8 + \delta_9 = 752.486' + ,, = 850.709' = 14^\circ 10' 43$

$\Delta_{10} = \Delta_9 + \delta_{10}\ 850.709' + ,, = 948.932' = 15^\circ 48' 56$

$\Delta_{11} = \Delta_{10} + \delta_{11}\ 948.932' + ,, = 980.020'\ 16^\circ 20' 0$

check Δ_{11} $\frac{\Delta}{2} = 16^\circ 20'$ okay